Acceptability of Frankfurters Made from Mechanically Deboned Turkey Frames as Affected by Formulation Changes

R. C. BAKER AND J. M. DARFLER
Department of Poultry Science, Cornell University, Ithaca, New York 14853

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ABSTRACT In a series of five experiments, the effect of type and level of fat and level of protein in frankfurters made from mechanically deboned turkey frames was determined. Series 1, 2 and 3 used chicken and pork fat and cottonseed oil at five levels (8, 13, 18, 23 and 28%), series 4 used the three fats at two levels (13 and 23%) and series 5, four levels of protein (9, 12, 15 and 18%). Evaluation methods included viscosity and stability of the raw emulsion, stability of the cooked emulsion, shear values and yields. The finished products were also examined organoleptically by a taste panel.

In general, higher fat levels produced firmer frankfurters, with more viscous emulsions and higher yields. The type of fat, at equivalent levels, had little or no effect on shear values or yields but the pork fat emulsions were slightly more viscous. Taste panel scores showed little difference between frankfurters made from chicken fat and pork fat at equivalent levels, but those made from cottonseed oil were less juicy and less flavorful and therefore less acceptable.

Increasing the protein level in the frankfurters increased shear values, emulsion viscosity and yields, and decreased taste panel scores for tenderness and juiciness. Flavor was unaffected. At the 9% level of protein, tenderness and juiciness scores were unacceptably high and the raw emulsion was in the range of instability (over 10% cookout).

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ONE of the more recent advances in poultry processing, and probably the most important from the standpoint of the economy of the poultry industry, has been the mechanical deboning of raw poultry. Backs and necks of chicken fryers, turkey frames and whole spent layers are now important sources of usable poultry meat. Since this product has a very small particle size, emulsion type products such as frankfurters and bologna are a natural use for it. A need has been felt in this laboratory and others for basic information on the capabilities and limitations of the material in making this type of product.

Work that has been done on the use of mechanically deboned poultry meat (MDPM) for emulsion type products includes the comparison of hand deboned meat and MDPM when chopped to various end temperatures (Froning, 1970) and the effect of pH adjustment and of the addition of salt 24 hours before processing (Froning and Janky, 1971). Cunningham and Mugler (1973) investigated the storage stability of weiners made from mechanically deboned spent layers. Schnell *et al.* (1973) made frankfurters from MDPM using several grinds and screen sizes in processing, and skin levels and additives in formulation. Young and Lyon (1973) used several levels of heat treated MDPM in chicken frankfurters and Baker *et al.* (1974) studied the effect of chopping time independent of end temperature on frankfurters made from MDPM from fryer backs and necks. No research, however, appears to have been done on the effect of level and/or type of fat or protein in the formulation of frankfurters made from MDPM. Since this information should be of value in improving the quality of these products, this study was undertaken.

Previously reported work on the effect of fat type and/or level of emulsion type products includes that of Swife *et al.* (1954) (beef bologna); Baker *et al.* (1969) (hand deboned chicken meat frankfurters), Townsend *et al.* (1971) (beef frankfurters) and Morrison *et al.* (1971) (beef, semi-model system). Research on the effect of level of protein on these

products includes that of Simon *et al.* (1965) (beef frankfurters) and Morrison *et al.* (1971) (beef, semi-model system).

MATERIALS AND METHODS

Source of Materials. Mechanically deboned poultry meat was obtained (frozen) from a nearby producer. The meat was from turkey racks, because of its low fat content. It was stored at −30° C. until used, no longer than eight weeks. Chicken fat was abdominal fat from fryers, pork fat was trim fat from hogs, and the oil was cottonseed oil. Proximate analysis by A.O.A.C. (1970) methods, of the MDPM was as follows: moisture—74.6%, fat—7.1%, protein—16.2%.

Methods. Frankfurters were made in five series of experiments, each repeated once, as presented in Table 1. Series 1, 2, and 3 used five levels (8, 13, 18, 23 & 28%) of cottonseed oil, pork and chicken fat, respectively. At the lowest level of fat, no fat was added; at the highest level, no water was added. Series 4 used two levels (13 and 23%) of all three fats. The amount of MDPM (and therefore the percent protein) was held constant and the water varied in opposition to the fat. Series 5 consisted of four levels of protein (9, 12, 15 and 18 percent) with chicken fat. The fat and water was decreased in a 1:2 ratio (fat to water) as the protein was increased, since this is the approximate ratio in the finished product. Salt, sugar, seasoning (a commercial blend) and cure were added in the same proportions for each batch. All emulsions were chopped in a Hobart food chopper to 12° C. ± 0.5, stuffed into #23 Nojax Casing, linked and cooked according to customary manufacturing procedures. After being held in a cooler at 2-3° C. overnight the frankfurters were peeled and used for testing purposes. At the time of stuffing, a portion of the raw emulsion was reserved, stored at 2-3° C. overnight and used for objective testing the following day.

TABLE 1.—*Formulae for frankfurters made from MDPM*

Variable	Ingredient		
	MDPM	Fat	Water
Level of fat (%)	g.	g.	g.
Series 1, 2, 3			
8	1600	—	600
13	1600	160	440
18	1600	320	280
23	1600	480	120
28	1600	600	—
Series 4			
13	1600	160	440
23	1600	480	120
Level of Protein (%)			
Series 5			
9	1050	302	848
12	1350	218	632
15	1700	165	335
18	2100	20	—

Objective Tests. Viscosity of raw emulsion: A portion of the raw emulsion, at 2-3° C., was packed into the extrusion cell of the Kramer Shear Press, with a 3.8 mm. orifice, and extruded, using a 20 sec. downstroke, and ten percent of a 2500 lb. proving ring. Maximum value in lb. of force required for extrusion was used as an indication of comparative viscosity.

Stability of raw emulsion: Thirty grams of raw emulsion were packed into polyethylene tubes, covered, and cooked in a water bath at 75° C. for 15 min. The rendered fat and juice were decanted into a graduated 15 ml. conical tube and the total volume was recorded. Results are expressed as % of the original sample.

Stability of cooked emulsion: Samples of the finished frankfurters were surface dried, weighed and heated for 5 min. in boiling 1% saline solution. After removal they were immediately surface dried on a paper towel and reweighed and the % gain or loss calculated.

Shear values: Frankfurters with the skin removed were cut into sticks, each weighing 13 g. ± 0.05. Sets of two were inserted crossways of the slots in the standard shear

cell of the Allo-Kramer Shear Press and sheared, using a 20 sec. downstroke. Results are expressed as lbs. of force per g. Three such sets per treatment were run.

Yields: Yields were determined by weighing before cooking and after removing the casing. Those lots which had fat and/or aqueous cookout were carefully wiped clean before weighing.

Water, fat and protein: These were determined on the raw material and end products using A.O.A.C. (1970) methods.

Subjective Testing. A trained taste panel composed of eight men and women was used for organoleptic evaluation. For testing, the frankfurters were immersed in boiling water in separate uniform containers, covered, and allowed to stand for 20 min. They were cut into thirds and served in coded sample cups with unsalted soda crackers and water for use between samples. The samples were evaluated for tenderness, juiciness, flavor and over-all acceptability using a scale from 1 to 9. In all cases, the higher numbers denoted the most tender and juicy, the best flavor, and the greatest acceptability.

RESULTS AND DISCUSSION

Series 1, 2 and 3: Effect of Level of Fat. When the protein content was held constant in the frankfurters and the water and fat content varied, higher fat levels produced firmer frankfurters, up to the 23% level when oil and pork fat were used. At the 28% level the shear values dropped slightly. When the fat used was chicken fat, no change was observed at the 28% level. Yields increased as fat level increased, since there was less water to be lost in cooking. Townsend *et al.* (1971) also found yields in frankfurters to be related to fat content.

Apparent viscosity of the emulsions increased with increased fat, pork fat emulsions having slightly higher comparative viscosities, at comparable levels, than those made with chicken fat or oil. Although this appears to be in opposition to the findings of Townsend *et al.* (1971), who found little difference in viscosity due to fat level, their measurements were taken at the end of chopping and at temperatures which intentionally varied considerably, whereas in this study measurements were taken at 2-3° after holding overnight to equilibrate. In addition, their method of measuring viscosity (Brookfield viscosimeter) differed from the method used in this study.

Taste panel scores also indicated that firmness increased with increased fat, with all the fats used. Moderate levels of fat had the highest scores for flavor.

TABLE 2.—*Effect of type and level of fat on emulsion viscosity and stability, yields and shear values of frankfurters made from MDPM*

Fat		Parameter				
			Stability			
Type	Level	Emulsion viscosity	Raw (total cookout)	Cooked	Yields	Shear values
	%	lb.	%	%	%	lb./g.
Chicken	13	86.3(2)	0.9(2)	+0.5(2)	88.8(1)	1.3(2)
	23	128.8	3.1	+0.2	88.0	1.6
Oil	13	85.0	0.9	+0.3	84.7	1.3
	23	130.0	1.1	+0.2	88.0	1.8
Pork	13	88.8	1.9	+0.8	85.5	1.4
	23	152.5	2.5	+0.5	88.3	1.7

(1) Each mean is the average of two runs.
(2) Each mean is the average of three measurements for each of two runs.

TABLE 3.—*Taste panel scores for frankfurters made with MDPM using two levels of three fat types*

Fat type and level	Parameter			
	Tenderness	Juiciness	Flavor	Overall acceptability
%				
Chicken				
13	6.3 (1)	6.2_{a}	6.2_{ab}	6.3_{a}
23	5.5_{bc}(2)	5.7_{a}	6.3_{ab}	6.1_{ab}
Oil				
13	6.0_{ab}	5.5_{a}	5.6_{b}	5.5_{b}
23	5.2_{c}	4.5_{b}	4.3_{c}	4.5_{c}
Pork				
13	6.11_{ab}	6.2_{a}	5.9_{b}	6.2_{a}
23	5.8_{abc}	6.0_{a}	6.8_{a}	6.6_{a}

(1) Each mean is the average of 16 judgements for each of two runs.
(2) Means followed by the same subscript letter are not significantly different at the 5% level.

Series 4—Effect of Type and Level of Fat. The type of fat used had little or no effect on yields, shear values of raw or cooked stability, at equivalent levels, as can be seen in Table 2. Emulsion viscosities were very similar, except in the case of the higher level of pork fat, which produced a more viscous emulsion. The level of fat, however, affected yields, emulsion viscosities and shear values, the low fat formulae producing lower yields, lower emulsion viscosities and lower shear values. Stability, both raw and cooked, were all within the range of stable emulsions.

Taste panel scores showed little difference between chicken fat and pork fat at equivalent levels (Table 3). Frankfurters made with cottonseed oil, however, were less juicy and had less flavor and were therefore less acceptable than those made with chicken or pork fat. The decrease in juiciness could be expected, since oil produces a tighter finer emulsion than does the solid fats (Townsend, 1971), with a resulting less juicy mouthfeel. Flavor differences were more pronounced at the higher level of fat. This may be a result of a lack of flavor in the oil, which contributed very little to the total flavor effect, and in fact may have diluted the flavors contributed by the meat and spices. In previous work in this laboratory (Baker *et al.*, 1969) using hand deboned chicken meat, and chicken fat, pork fat and oil at the 25% level, no differences in flavor were found due to type of fat. This apparent contradiction may be due to several factors. For instance, the meat differed (hand deboned chicken *vs.* mechani-

TABLE 4.—*Effect of level of protein on emulsion viscosity and stability, yields, and shear values of frankfurters from MDPM*

Protein level	Parameter				
	Emulsion viscosity	Emulsion stability Raw (total cookout)	Cooked	Yields	Shear values
%	lb.	%	%	%	lb./g.
9	38.8(2)	11.6(2)	−0.2(2)	84.6(1)	0.6(2)
12	60.0	5.5	+0.4	85.4	0.9
15	96.3	2.2	+0.4	86.2	1.3
18	162.5	5.8	+0.4	87.3	2.5

(1) Each mean is the average of two runs.
(2) Each mean is the average of three measurements for each of two runs.

TABLE 5.—*Effect of level of protein on taste panel scores for frankfurters made from MDPM*

Protein level	Parameter			
	Tenderness	Juiciness	Flavor	Overall acceptability
%				
9	8.9_a(1) (2)	8.6_a	6.8_a	3.6_c
12	7.9_b	7.8_b	6.9_a	5.3_b
15	5.6_c	5.8_c	6.6_a	6.9_a
18	3.8_d	4.6_d	6.9_a	4.9_b

(1) Each mean is the average of 16 judgements for each of the two runs.
(2) Means followed by the same subscript letter are not significantly different at the 5% level.

cally deboned turkey), and the discrimination of the taste panel may have improved, some of whom had five more years of taste paneling experience.

Taste panel scores for tenderness were always higher for the lower level of fat than for the higher level, although they were not always significantly different. Juiciness was little affected, except as previously noted in the case of the high level of oil. The higher level of fat affected the flavor differently in all cases: chicken showed little or no difference, pork fat improved the flavor at the higher level, and oil, as previously commented on, had a detrimental effect. Scores for flavor were reflected in the scores for overall acceptability.

Series 5—Effect of Level of Protein. As can be seen in Table 4, the effect of increasing the level of protein was very clear-cut. Yields, emulsion viscosity, and shear values increased as protein was increased. All lots showed good cooked stability, but the raw stability test showed that the most stable emulsions were obtained at the 15% level of protein, the stability decreasing both above and below that level. Only at the 9% level however, could they be considered unstable, since the cook out was over 10% (Morrison, 1971).

Taste panel scores (Table 5) for tenderness and juiciness decreased with increased protein. Flavor was unaffected. Overall acceptability was highest for the formulae containing 15% protein, indicating that at this level the tenderness and juiciness of the frankfurters were optimum. At the 9% level tenderness and juiciness scores were very high and the overall acceptability was quite poor.

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The Effect on Xanthophyll Content and Color of Broiler Skin When Scald Additive Concentration Was Measured by pH[1,2]

J. L. HEATH AND C. J. WABECK
Department of Poultry Science, University of Maryland, College Park, Maryland 20742

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ABSTRACT Three experiments were used to determine that scald water pH could be altered by changing the concentration of a commercial scald additive without affecting color of the skin. The pH of the scald water which indicated the optimum level of additive for feather removal also retained the most yellow color in the skin. The pH of the scald water must be monitored constantly to maintain an optimum concentration of additive. The temperature of the scald water did not alter the lack of influence scald water pH had on skin color.

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INTRODUCTION

SEVERAL companies market a product to the poultry processing industry which, when added to the scald water, will increase the efficiency of the feather removal operation. One characteristic a large number of these scald additives have in common is they increase the pH of the scald water. The methods used to maintain concentrations of these additives require the addition of a specified amount per bird scalded. This is done by metering or periodic addition. These methods allow a wide range of scald water pH to develop in a given period. The use of pH to measure and maintain a given concentration of additive has been suggested. The effect of scald water pH on the carcass has not been determined. Previous work, Heath and Thomas (1973, 1974), indicated scalding and picking conditions will alter the xanthophyll content and yellow color of the skin.

This research was designed to determine if skin color was affected by scald water pH when increased by changing the concentration of a commercial additive.

MATERIALS AND METHODS

Eight-week old male broiler chickens were used in the experiments. The broilers were reared and processed according to the method of Heath and Thomas (1974). A portion of skin was removed from the left side of the

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2. The use of trade names in this publication does not imply endorsement of the product by the University of Maryland.